SCIENCE:

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WE have received a copy of the *Annuaire de l'Observatoire Royal de Bruxelles*—a book of nearly four hundred pages, published under the supervision of Dr. J. C. Houzeau. This number is the forty-eighth issue of the series, and contains the customary data regarding calendars; rising, setting and meridian passages of the sun, moon and planets; eclipses of the sun and moon, and transit of Mercury; occultations of stars by the moon; eclipses of the satellites of Jupiter; positions of fixed stars; elements of the planets and their satellites, and of the periodic comets; various data pertaining to weights and measures, geographical positions, etc. It is a noteworthy fact, that while the astronomical repertoire supplies a need for Belgium—as the similar *Annuaire du Bureau des Longitudes* does for France—we have no like publication in America. It must cost really very little to print it, and the expense of compilation can not be great. It is not a little remarkable that Americans generally should so long be content with dependence upon patent medicine almanacs for this class of information.

Among the appended articles, we note a few which carry more than a passing, special interest—*Le Globe Terrestre—Quel est le Climat le plus Favorable au Développement de la Civilisation?—L'Astronomie dans l'Antiquité—L'isthme de Panama.* Monsieur L. Niesten, a well known astronomer of the Royal Observatory, contributes no less than four articles to this issue of the *Annuaire*, two of which appear to have been prepared with great care, and are astronomically of much importance. The last transit of Mercury, May 6, 1878, was very fully observed everywhere, and M. Niesten deserves much credit for his well arranged digest of every sort of observation on that occasion. Those who are concerned with general relations on the rapidly multiplying group of small planets will get a deal of information from Niesten's article, *Les Astéroides*—which is, in fact, a comprehensive history of these bodies. An accompanying map serves to bring out some points which are made clearer by graphical representation. Astronomers and others will have frequent occasion to refer to an article (which it is remarkable should not have long ago been prepared by some one)—*Nomenclature des Observatoirés Astronomiques Existants, qui out la Caractère d'Etablissements Publics.* About 120 observatories are included in this list, and there are given, as far as known, the year of founding, the connection of the observatory, some brief description of the instruments, and the names of all the directors of each establishment, including the dates of their installation.

THE AMERICAN CHEMICAL SOCIETY.

The June meeting of the American Chemical Society was held Friday evening, the 6th inst., Prof. A. R. Leeds presided. Mr. A. P. Hallock was elected a regular member. The first paper before the Society was by Dr. Chas. A. Doremus, "On the Composition of Elephants Milk." The sample was obtained from the mother of the baby elephant "America" which is now on exhibition in this city. The baby weighed 213½ pounds at birth and at the end of a year turned the scales at 900 pounds. Considerable difficulty was experienced in procuring the sample, and but a very small quantity was obtainable. Three analyses were made and the figures are herewith given:

	I. April 5. Morning.	II. April 9. Noon.	III. April 10. Morning.
Quantity	19cc.	36cc.	72cc.
Cream, per cent	52.4	58.	62.
Reaction	Neutral.	Slightly alkaline.	Slightly acid.
Sp. Grav	....	.....	1.0237
IN 100 PARTS BY WEIGHT.			
Water	67.567	69.286	66.697
Solids	32.433	30.714	33.303
Fat	17.546	19.095	22.070
Solids in fat	14.887	11.619	11 233
Casein	14.236	3.694	3.212
Sugar		7.267	7.392
Ash	0.651	0.658	0.629

It will be noticed from these analyses that the milk is peculiarly rich in the nitrogenized materials. The volume of cream compared with that obtained from an Alderney cow is also quite large. Under the microscope the milk globules appeared very uniform in size and were unusually clear. Although it is generally claimed that the fat when burned emits a peculiar odor by means of which it is possible to distinguish the animal from which it has been obtained, yet in the present instance no odor was perceptible from the fat which was separated from the milk. This is the only analysis of elephant's milk on record, and Dr. Doremus is certainly deserving of much credit for the interesting information which he has obtained. His entire paper will be published in the proceedings of the Society. An analysis of the milk of an hippopotamus is added for the sake of comparison:

Water	90.43
Solids	9.57
Fat	4.51
Casein, and milk sugar	4.40
Ash	0.11

SLEEP AND SOMNAMBULISM.*

By M. Regnard.

[Translated From the French by the Marchioness Clara Lanza.]

II.

Ladies and Gentlemen:—In the middle ages and up to the present century Somnambulists, together with epileptics and hysterical women, were classed with sorcerers and those supposed to be possessed by the devil. They were exorcised with others afflicted in similar ways and generally burned alive with great ceremony and rejoicing.

During this unenlightened era, one man of genius proved himself, in regard to Somnambulism, to be an exceptional observer and has left us a description of it which no modern neurologist would repudiate. His name, gentlemen, is upon your lips. It is Shakespeare who in his tragedy of *Macbeth* has given us a masterly description of automatism. You are all familiar, doubtless, with the sleep-walking scene, but I will recall a portion of it to your mind. After having committed her terrible crimes Lady Macbeth has attacks of Somnambulism. One of her ladies in waiting informs the court physician and both sit up at night to await the coming of the queen.

"*Gentlewoman*—Lo you, here she comes! This is her very guise; and, upon my life, fast asleep. Observe her: stand close.

Doctor.—How came she by that light?

Gentlewoman.—Why it stood by her: she has light by her continually: 'Tis her command.

Doctor.—You see her eyes are open.

Gentlewoman.—Ay, but their sense is shut.

Doctor.—What is it she does now? Look how she rubs her hands.

Gentlewoman.—It is accustomed action with her, to seem thus washing her hands; I have known her continue in this a quarter of an hour.

Lady Macbeth.—Yet here's a spot.

Doctor.—Hark! She speaks: I will set down what comes from her, to satisfy my remembrance the more strongly.

Lady Macbeth.—Out, damned spot! Out, I say!—one; two; why, then, 'tis time to do 't:—Hell is murky!—Fie, my lord, fie! A soldier and afeard! What need we fear who knows it, when none can tell our power to account?—Yet who would have thought the old man to have had so much blood in him?

Doctor.—Do you mark that.

Lady Macbeth.—The Thane of Fife had a wife; where is she now?—What, will these hands ne'er be clean? No more o' that, my lord, no more o' that; you mar all with this starting.

Doctor.—Go to, go to; you have known what you should not.

Gentlewoman.—She has spoke what she should not, I am sure of that; heaven knows what she has known.

Lady Macbeth.—Here's the smell of blood still; all the perfumes of Arabia will not sweeten this little hand. Oh! Oh! Oh!

Doctor.—What a sigh is there! The heart is sorely changed.

Gentlewoman.—I would not have such a heart in my bosom for the dignity of the whole body.

Doctor.—Well, well, well.

Gentlewoman.—Pray God it be, sir.

Doctor.—The disease is beyond my practice; yet I have known those which have walked in their sleep, who have died holily in their beds.

Lady Macbeth.—Wash your hands, put on your nightgown; look not so pale—I tell you yet again, Banquo's buried; he cannot come out of his grave.

Doctor.—Even so.

Lady Macbeth.—To bed, to bed; there's knocking at the gate. Come, come, come, come, give me your hand; what's done, cannot be undone. To bed, to bed, to bed.

Exit.

Doctor.—Will she go now to bed?

Gentlewoman.—Directly.

Doctor.—Foul whisperings are abroad; unnatural deeds
Do breed unnatural troubles. Infested minds
To their deaf pillows will discharge their secrets.
More needs she the divine than the physician.
God, God, forgive us all! Look after her:
Remove from her the means of all annoyance,
And still keep eyes upon her. So good night;
My mind she has mated, and amazed my sight;
I think but dare not speak.

Gentlewoman.—Good night, good doctor.

Gentlemen, do you not think this fine description contains all the details I previously gave you, and that Shakespeare has shown himself scientifically superior to all who have hitherto attempted to represent this singular nervous affection?

I have now finished what I had to say about natural Somnambulism and find myself confronted by the most difficult point of my subject, provoked or induced Somnambulism—Magnetism if you insist upon my employing that detestable word.

It is quite possible by means of various practices which I shall make known to you later, to produce a nervous affection very similar to Somnambulism, but yet differing from it in several ways. The effects obtained depend of course upon the subject and the methods employed, and the conditions resulting from these may be divided into three, all of them however, being sometimes induced in a single person. These three states are:

1. Hypnotism.
2. Sleep.
3. Catalepsy.
4. Automatism.

Gentlemen, during the latter part of the foregoing century an Austrian physician of great repute, seemingly, arrived in Paris. His name was Mesmer and he had discovevered the means, by a purely physical process, of producing certain effects upon the human organism which were considered to be perfectly prodigious. Mesmer appeared first about the time when great excitement was being caused by the first discoveries in electricity, made by the Abbè Nollet, and when the singular action produced upon a magnetized needle by a fluid apparently permeating the earth, attracted universal attention. Mesmer announced that he was master of another fluid which was but a modification of the terrestrial one and which operated upon the vital forces, and when properly directed could become a most important curative means.

He made an offer to the government to sell his secret which he estimated to be worth several million francs. The French ministers, however, were prudent and allowed Mesmer to keep the great mystery to himself.

His method had nothing about it resembling real magnetism. His performances took place in a partially darkened room in the middle of which was placed a large tub generally covered. A number of rods were placed crosswise on the top around which the people seated themselves. Soon the sound of a piano was heard, while the atmosphere grew heavy with perfumes. Mesmer walked about the room with a prophetic air, touching the forehead of each person, and executing a series of theatrical gestures. The subjects then fell into a comatose state. They remained in ecstasy, almost entirely deprived of sensibility and movement, and only recovered under the influence of broad daylight and fresh air.

There was not a bit of Magnetism in all this. The subjects were generally hysterical women. Their imagination was greatly excited and the same thing recurred to them as now happens to those persons we hear of as being afflicted with religious mania, etc.—they were hypnotized.

*A lecture delivered before the *Association Scientifique de France.*

To Mesmer we cannot even give the credit of invention, for hypnotism or uncompleted Somnambulism or ecstatic sleep, as you choose to call it, occupies still as it did then a high place among certain religious sects. It is nothing more than *ecstacy*, where exterior comprehension is lost and replaced by a series of visions *en rapport* with the preoccupation of the subject. I will show you presently that although ecstasy is generally of a religious character, there are many exceptions and that in fact any vivid mental emotion can provoke it.

The fakirs of India frequently induce the condition, not by absorbing themselves in some holy or poetical idea, but simply by gazing fixedly at space or some bright object or spot; some of them look at the end of their nose. The Grecian monks are also celebrated for being able to produce Hypnotism by looking steadily at a certain point or thing, and will remain insensible for hours. The result of this is that they enjoy the reputation of either holiness or witchcraft, according to the form of the delirium which usually follows.

At all times that which was called *contemplative asceticism* has been produced by fixing the gaze upon some brilliant or shining object to which was attributed some particular virtue or sacredness. These contemplations, together with violent mental excitement, were rapidly succeeded by hallucinations, apparitions, and in short, ecstasy.

Mahometanism even, although not particularly mystical, has likewise produced special forms Hypnotism. A prolonged and monotonous sound in these cases was more effectual than a fixed gaze.

Among the disciples of Hussein, the martyr, ecstacy is induced by means of tambourines beaten incessantly in a rapid and monotonous manner, accompanied by measured chanting. This ceremony frequently occurs at night, and in a short time the subjects are in a state of ecstacy, in which cutaneous insensibility is so marked that all the tortures undergone by the martyr can be likewise inflicted upon them without eliciting a cry or groan.

But these phenomena are shown in still more intense a manner in the sect of Aissaoua, many representations of which can be met with in our Algerian colony. Those who have had the rare good fortune of witnessing one of their ceremonies have been struck with the degree of anæsthesia which seems to affect these people.

The ceremony takes place at night, generally in some deserted plain. The tambourines keep up a constant monotonous sound. The subjects seat themselves about an immense fire and gradually fall into a condition of ecstacy. Some of them writhe convulsively and utter prolonged cries. Anæsthesia becomes complete and then some can be seen applying their tongues to bars of red hot iron, while others eat Barbary figs, the long thorns of which come directly through their cheeks from the inside, causing their faces to stream with blood. Still others swallow live spiders and scorpions, which remarkable feats often result very seriously.

In short, all Hypnotics proceed precisely the same way, by fixing the eyes, generally squinting, upon a certain point, or else listening attentively to a monotonous sound.

These methods which have been and always are employed to produce the phenomena, are, as we shall see, quite determined.

We are indebted to Braid for the first well regulated and experimental work upon Hypnotism, and in 1841, this English surgeon, after having witnessed so-called magnetic experiments, discovered that the prolonged fixture of the eye or hearing, and not a mysterious fluid, was the source of the incontestable phenomena he had observed. Scientific Magnetism, we may say, began with Braid.

He knew a series of experiments, for the most part extremely curious, which had just been made in France by Dupotet and Puységur. These two men, who were imbued with Mesmer's ideas, had wondered if the tub were really necessary, and if the magnetic fluid we all possess could not be transmitted from one person to another. They therefore procured a number of nervous persons and endeavored by a series of motions which nowadays we designate as passes, to realize some palpable effects. By this means sleep was produced much more rapidly than by Mesmer's method. Magnetism had been effected by communication, and it exists to this day, considerably augmented and enriched by all sorts of inconceivable folly.

Braid asked himself whether passes did not constitute a simple hypnotic process, and whether the contemplation of a fixed or moving point would not produce the same result as all these absurd magnetic gestures. His experiment was crowned with success, and his subject fell into the hypnotic sleep by simply looking at a metal ball. The magnetic fluid had been overturned!

The condition formed in this purely physical manner was such, and the insensibility so complete, that Braid was able to operate upon the subjects, and even amputate their limbs. His experiments were repeated in France by Broca, Verneuil and Laségne, the same results making themselves apparent.

Unfortunately, hypnotism cannot be induced with everybody. A number of unsuccessful attempts have always been observed, and then came the introduction of chloroform and ether. Braid's experiments were lost in oblivion until a courageous French *savant*, Professor Charcot, took them up, and brought them to points, which I shall proceed to demonstrate.

But first of all, let me show you some experiments in hypnotism. Animals can be hypnotized by Braid's process as well as human beings.

Here is an old experiment borrowed from Father Kircher. I take a hen and place it upon this black table in a sitting position, its head resting on the table. I then trace a chalk line from the end of its beak, upon which its eyes are instantly fixed. I remove my hands, and you see the hen remains motionless. I can pinch it and burn it, still it does not move. If I replace the chalk line by an electric light, the effect will be still more intense. This fact is equally noticeable in man, a sudden surprise can produce the same effect. I seize the chicken brusquely and place it rudely upon the table. It is motionless, hypnotized, Preyer says cataleptic, the word is, however, of no consequence. The same experiment is very successful, you also see, with a sparrow. If the bird's head be placed beneath his wing, the hypnotic sleep lasts a very long time.

A Guinea pig can be easily hypnotized. I take one of these little animals, a female, for M. Laborde has shown that the experiment is only successful with this sex, and I extend it brusquely upon its back. You see that it remains as I have placed it without moving, and that it is insensible, for I pinch it with all my strength.

Here is another one upon whose ears I hang some brilliant bits of steel. It turns its head from side to side to look at them, and now has fallen asleep so soundly that I cannot wake it. I fire a pistol so close to its ear that its moustache is singed, but it does not move.

These animals are hypnotised; their condition consists in a total loss of sensibility. But they are not asleep, they do not dream, they are not somnambulists.

Hypnotism can be produced in almost any one who makes himself perfectly passive. But if you experiment upon one of those persons whom we call hysterical you will obtain quite a different condition. The same means bring you to *artificial somnambulism*. The difference in the subject produces the difference in the effects. Here it is that M. Charcot's experiments and the Salpêtrière investigations begin, in which I was kindly permitted to assist.

I must first of all tell you what a hysterical subject is and what constitutes the principal phenomena she presents, for we shall see that her condition of Somna-

bulism is a mere modification, sometimes a simple reproduction of them.

A hysterical woman at first sight cannot be distinguished from any other, unless we except a rather strange expression of face and a peculiarity of dress. These persons always cover themselves with several loud colors which do not harmonize in the least. I shall soon tell you the reason of this.

The first thing to be observed in them is *anæsthesia;* hysterical women are sometimes paralyzed on one side of the body and sometimes on both. They can then be pierced with long needles without feeling anything whatever, and fall into all sorts of singular errors as one side of their body seems to be dead. They do not know where their arms or legs are unless they look at them. Sometimes they allow themselves to be burned without percieving it. One day, a hysterical patient at La Salpêtrière found a hole in the stocking she was about putting on. She sewed it up, and walked about all day. On going to bed that night she was unable to remove the stocking, and on calling for help it was discovered that she had sewed it to her foot.

A French physician, M. Bureq, has shown that the application of metal to the insensible parts render them sensible. This is called *metallo-therapy*, and singularly enough, the committee who examined this phenomenon affirmed that while sensibility returned to one arm, for example, it disappeared in the other at precisely the same point, so that the subject was in no wise benefited.

Anæsthesia of the skin also extends to the other senses. Hysterical women do not hear well, their sight is defective and, generally speaking, they are unable to distinguish colors; sometimes with one eye and often with both they are *achromatopsic;* everything looks gray to them. Their senses are therefore in a state similar to sleep, from which certain exciting influences such as metals, electricity, etc., can rouse them temporarily.

Their muscles are frequently paralyzed. There is nothing in fact, more common than a hysterical paralytic. Sometimes the muscles are violently contracted, and remain thus for years. An intense emotion can suddenly stop the paralysis in contraction. I need not tell you how this is achieved.

These contractions also, can be induced easily. It is only necessary to rudely sieze the arm of a hysterical woman and it will remain contracted in whatever position you place it. In short, these people have periodical attacks in which they reproduce nearly everything that we can obtain from them by magnetism.

When a hysterical woman is about to have one of these attacks, the first thing she experiences is a certain uneasiness and discomfort, as though a ball rose from her stomach and remained stuck in her throat. This is nothing more than muscular contraction of the œsophagus. Suddenly, she utters a loud cry and falls backwards. Her eyes roll wildly and a sort of foam appears upon her lips. Simultaneously, her arms are violently extended and her clenched hands turned towards the inside. The entire body becomes as rigid as in an attack of Tetanus. Then the patient utters a prolonged scream, bends her body in the form of an arch in such a way that her weight is sustained solely upon the head and heels. This period is succeeded by all kinds of disordered movements which last from two to three minutes. Then contraction begins. Sometimes the whole body contracts, sometimes only a portion. In this way, the contraction of the arms frequently places the patient in the attitude of the crucifixion and this last generally for days accompanied by complete insensibility. Then intervenes a period of repose. One would say that it was all over and that the patient slept. But indeed it is but the beginning of the final and most interesting period of all, the ecstasy which M. Charcot has termed *attitudes passionnelles.* The patient absolutely ignorant of all her surroundings, neither perceiving sound or light, begins to follow out a dream which has the peculiarity of being always the same and is the reproduction of some event, or series of events, belonging to her existence. My friend M. Bourneville, physician to L'Hospice de Bicêtre, and myself have published a book wherein all these facts are minutely described. It is called the *Sconographic photographique de la Salpêtriere* and comprises the entire study of hysteria as well as Somnambulism. The descriptions are completed by a series of pictures produced by an instantaneous photographic process, and these I shall now proceed to show you.

In the *attitudes passionnelles,* the hysterical patient is really a spontaneous and automatic somnambulist. You will now understand why it will be so easy presently to put her in a condition of artificial Somnambulism. I will show you some *attitudes passionnelles.* The patient sees some frightful object as you may imagine by her terrified position. But see, her features relax and here we have religious ecstasy. Once more the scene changes to give way to this when she keeps time to music which she thinks she hears.

The young girl represented in these photographs has been subject to these attacks for six years. Her hallucination or dream has never changed in a single detail, and there are a hundred more precisely like her in Paris.

Gentlemen, you will probably ask if this terrible disease, so much talked of at the present day, is new—if it is a production of this "nervous century," if I may so express myself, or whether it is of ancient date. My reply is a simple one. Hysteria is as old as humanity itself. No matter how far back you may travel in the history of the world, you will always find it. What, indeed, were the pythonesses, the ancient sibyls, the sorceresses and possessed of the middle ages, if not somnambulists and hysterical women? The descriptions of their paroxysms cannot leave us in doubt, for their characteristics are plainly shown. Do we not know that they were pricked and burned without being aware of it. And did not this very fact prove that the devil had set his stamp upon them, and did it not invariably result in their being butchered alive? Better still, painting assists us to form a vivid impression of these attacks. Look at the "possessed" which figure in the works of Rubens, Raphael, Jordaens and Breughel, and you will immediately recognize the attitudes which I have just shown you in the photographs. Here are some copies of these famous pictures. Look at them and see if you can doubt for a moment.

This long diversion I have made purposely, that you might fully comprehend the precise ground upon which we stand. The means employed to produce Hypnotism can induce hysterical manifestations similar to those produced spontaneously. These manifestations are *artificial Somnambulism, Catalepsy* and *Automatism.*

To provoke Somnambulism requires a very simple mode of operation. It is the same as that employed to induce Hypnotism. You can make the person fix her eyes upon a bright object. Ordinarily, however, you seat yourself directly in front of her and tell her to look at you steadily. After a minute or two has elapsed, you see her eyes assume a vague expression, then fill with tears, and finally, in a short time, varying from a minute to a quarter of an hour, according to the subject, they close, the head falls and sometimes a little foam appears upon the lips. Sleep is produced, real sleep accompanied by total loss of sensibility. This is, therefore, more than Hypnotism.

If the subject is restless, her thumbs can be held in the closed hand. As for passes, I have always observed that they retard the sleep instead of promoting it. M. Richet, on the contrary, places great faith in these movements.

You see, gentlemen, that nothing can be more simple. A little patience the first few times and the thing is done. There is no fluid, be it understood; the *magnetizer* has

nothing individually to do with the phenomenon. All that takes place originates with the *subject* whose brain is actually annihilated and brought to such a condition that any dream can be provoked by *suggestion*. We have in fact, an automaton similar to that which I called your attention to in Natural Somnambulism, only while the latter merely obeys the impulse of memory, the former is subject to our will.

Hypnotism can also be produced by simply placing the thumbs gently upon the closed eyelids of the subject, allowing the hands in the meanwhile to rest upon his temples and press upon the eye-balls. This process is very effectual with some subjects. A person accustomed to be hypnotized can be put into the condition by having some one shout suddenly and authoritatively in his ear, "Sleep!" A theatrical gesture accompanying the command makes it more effective. The Abbé Faria, a celebrated charlatan who completely mystified the world about twenty years ago, always adopted this method. The other ways, however, are preferred at La Salpêtrière, and also at Breslau by the well-known Professor Heidenhaim.

All that I have just said refers to the first experiments made with subjects. After they have once been hypnotized, however, the state can be induced much more easily. Here it is that Imagination steps in and mountebanks are allowed the utmost liberty of action. The mere idea that he is about to be put to sleep causes the subject to fall asleep almost immediately. If, in addition, he is made to think that the operator possesses some secret influence, or supernatural power, you will soon see what may happen.

A patient at La Salpêtriére, who had firmly persuaded herself that I had a peculiar influence upon her, fell into a hypnotic condition every time she saw me, independent of the locality. She often became hypnotized upon the staircase or in the middle of the courtyard. One day some one said to her jokingly that she could be hypnotized simply *by the will* in the midst of a public ceremony which was to take place a few hours later, and she actually refused to appear on this occasion so fully was she convinced that what had been mentioned would really occur. In such cases, the imagination is everything. The subject alone is responsible for all that happens. A few examples will make you thoroughly understand what I mean. I have actually succeeded in persuading patients that they could not leave the room because I had magnetized the door-knobs. They would hesitate for a long time before approaching them, and ss soon as they touched them they became hypnotized. Need I tell you that nothing whatever had been magnetized? This experience is important, for by means of it we can explain cases in which the subjects fall into the condition while drinking a glass of *magnetized water*, or while lying down beneath a *magnetized tree*.

Magnetic experiments made at a distance belong to the same category. How often we have read of magnetizers who have succeeded in putting subjects into a deep sleep while the former is in one room and the latter in another. Here again the subject alone is the agent, I have frequently tried this experiment. A patient named P—— was told, "M. Regnard is in the next room and he is magnetizing you." She would instantly exhibit great uneasiness and then fall into a deep sleep. This even happened when I was not in the next room or even in France, and when, I am free to confess, I was thinking of anything rather than her.

On another occasion I said to a patient that I would magnetize her at three o'clock in the afternoon, and ten minutes after making this remark I had forgotten all about it. On the following day, however, I learned that she had fallen asleep precisely at three o'clock.

The immense number of absurdities which go to compose magnetizer's guide books can be explained in this way. The imagination of the subject is vividly affected and sleep is produced subjectively and without the intervention of any exterior influence. No matter what manner of *Magnetism* is employed the result is always precisely the same—the subject remains inert.

Different peculiarities are then observable, the most important of which is hyper-muscular excitability. In a normal condition our muscles are very susceptible. Any violent check causes them to contract, and the same effect is often produced by reflex action.

In artificial Somnambulism, the action of the spinal cord being no longer moderated by the brain which is annihilated. the muscles contract by reflex action beneath the very smallest influence. Pass your finger as lightly as possible over the forearm of a sleeping hysterical woman and you will immediately perceive muscular contraction. Charlatans obtain this effect by gently touching the muscles while apparently only making passes. By causing the muscles of the back to contract subjects can be made to assume positions which appear incompatible with the equilibrium. Here are a couple of photographs taken of two somnambulists. One of them, you see, has her head thrown back until it nearly touches her waist, while the other rests with her feet on the back of one chair and the nape of her neck on the other, her body bent in the form of an arch. I show you these two positions, so frequently exhibited by would-be performers of miracles, simply that I may explain to you how I obtained them.

All the results reached so easily in magnetic sleep are nothing more than hysterical muscular contraction. This can be proved by the fact that if the patient is awakened during this state, the contraction remains indefinitely, and in order to remove it she must be put to sleep again, and antagonistic muscles contracted.

The study of this important branch of the subject led M. Charcot and his students to the investigation of a most curious thing, and one which has helped to calm the fears of people, who, without witnessing the experiments performed, denounced the whole affair as an imposition.

Gentlemen, there are about two thousand persons in this room. With the exception of a few physicians who are present, it is probable that none of you know the action of the muscles as described by Duchenne, of Boulogne, nor yet the distribution of the nerves situated in the arm. Do you believe that a girl who can neither read nor write, and who comes from the most obscure portion of Brittany, could be versed in the details of this delicate physiology? For my part, I do not believe it. If she is an imposter, we shall soon discover it. Here she is; let us hypnotize her, and then excite the cubital nerve at the elbow, and see if she makes a wild gesture. Not at all; she merely bends her little finger, the third finger and thumb. The cubital nerve therefore, only affects these three fingers. Many medical students of my acquaintance are ignorant of this fact. Let us now excite the sterno-mastoid muscle, this diagonal cord which appears upon the neck when the head is turned. You see, she turns her head towards the opposite side. Better still, let us excite the face muscles with this pencil, and you perceive the same effects appear as were obtained by Duchenne with electricity, such complex effects, too, that even physiologists have difficulty in remembering them. If this girl is only pretending, she is exceedingly clever. I shall have finished my remarks upon sleep, after having told you that it is quite possible, at this period, to make the subject rise and follow you, and utter loud cries, should any one come between you and her.

The second state which can be produced by Hypnotism upon hysterical subjects, is Catalepsy. This *bizarre* condition, of which I shall attempt to give you an idea, exists normally in the patient, and the processes employed only serve to develop it. Sometimes it appears without any provocation whatever. Nothing is easier than to make the subject pass from a sleeping state to a cataleptic one. It is only necessary to open his eyes suddenly, and he will then remain as though transfixed. His eyes assume a

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There has been formerly a manifest tendency to belittle small things and apparently insignificant phenomena, and bestow the greatest attention on those matters which impress the observer by their magnitude. Modern science has done away considerably with this erroneous method and has taught us that it is the little things which achieve great results in nature, as a rule. To this class of phenomena, which has been habitually underrated until a comparatively recent time, belong the meteorites, shooting stars and meteoric dust generally. Chladni's view that they fall from the skies, pronounced in 1795, was ridiculed by the learned men of the times. One member of a committee sent by the French Academy to investigate the fall of a meteorite in the neighborhood of L'Aigle, Le Luc, declared that he would really be forced to believe what the people who witnessed the fall said, if he did not know that such a thing was *utterly impossible.*

It was not long, however, until the celestial origin of these bodies was universally recognized, several other falls of large meteorites occurring during the first decade of the present century, which could no longer be explained away. After this various stones that were known to have fallen upon the earth were examined and described, and a good many more which were recognized to be of celestial origin. The number of all the various specimens thus investigated has gradually become very large. Kesselmayer, in his great work on the subject, describes 647 distinct falls.

It is not now necessary to recall the several results of these investigations, nor to describe the peculiar properties of meteorites on which the resemblances and differences between those celestial minerals and our terrestial rocks are based. Suffice it to state that between the two types which have been recognized, viz: those consisting exclusively of iron, and those which are composed of certain silicious minerals, such as Augite, Bronzite, Olivine, Anorthite and other Feldspars, there are all the possible combinations of both; the ferrous meteorites predominate, however, those with a considerable percentage of silicious constituents being comparatively rare, and the purely silicious still more so.

It is the latter, the silicious material, which has been examined with such remarkable results by Dr. Hahn. This occurs usually in light-colored spherical or pear-shaped masses (*χονδροί*) similar to the nests of crystals (druses) which are a well-known occurrence in crystalline rocks. These peculiar forms consist principally of Bronzite and Enstatite, which to the naked eye show an appearance graphically described by Kesselmayer twenty years ago.

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This successful amateur, for such he was before he succeeded in gaining his present reputation by his participation in the debate on the "*Eozöon canadense,*" and then resigned his government position to pursue this peculiar line of research at his leisure—this "Gerichts-Referendarius, a D." has by an ingenious application of the comparatively new method of making transparent sections of these meteorites accomplished results of which many a specialist might be proud. In order to exclude the error to which human vision and draughtsmanship might be liable, he has prepared photographic reproductions of his specimens, and on 32 excellent plates he presents the scientific world with 142 of these highly interesting preparations. Most of the fossil structures thus revealed belong to the animal world, indeed, Hahn himself professes that he is unable to find evidences of vegetable organisms; these, however, since the appearance of his work in February, have been recognized by Prof. Karsten, of Schaffhausen, Switzerland, in sections prepared by him from a portion of the very meteorite in his possession which has furnished a considerable number of Hahn's specimens. Two of these Prof. Karsten has drawn, and the cuts are published in an exhaustive paper on Hahn's book, together with his own observations and those of others on this very subject in the German Journal "Die Natur," edited by Mr. Karl Mueller, of Halle, Prussia.

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resembling to the *Favosites Goldfussi* * from the Silurian *Grauwacke,*' another is compared to the *Calamopora Naumanni* from the same strata.

The structure of these corals is excellently preserved; the columnar structure, the stomata, the rays in the cells, indicating the partitions between the columns in cross-sections, in short, all the various parts can be perfectly well demonstrated.

Of Spongiæ Dr. Weinland has already determined three different genera. Of a peculiar bluish-colored sponge he says he could draw a perfect picture, so numerous are the various longitudinal and cross-sections in which it occurs, it would be as easy as it would be to draw it from a living sponge.

Algæ have also been recognized as forming part of this intricate network of fossils. Dr. Weinland has determined several as belonging to the *Cocconeis*, while Prof. Karsten describes others belonging to the genera, *Leptothrix*, *Leptomitus* and *Hysterophyma*. (The latter gentleman reminds the reader of the fact, that Reinsch has lately demonstrated the existence of these and other Algæ in coal, some of his specimens containing as much as twenty per cent of such organisms.

But what is the most interesting feature of all the organisms thus ingeniously and unexpectedly brought to light in meteorites is their Lilliputian size. The coral-tree, above referred to as a *Favosites*, presents itself to the naked eye as a white spot on the section, not larger than a pin's head. Its greatest diameter measures nine-tenths of a millimeter, and the single cells not more than about five one-hundreths of a millimeter. All the other organisms detected show the same pygmean proportions, the spiculae of sponges, for instance, being absolutely indefinable to the naked eye.

The origin and formation of these celestial fossils could not possibly have been different from what we know it to be with our terrestrial specimens. They tell us of a planet, on which aquatic life was sufficiently developed to produce them and to preserve them after death by a process of infiltration with silicious material, which dissolved the lime of which these structures must have consisted as far as their inorganic constituents are concerned, and supplanted it by the various kinds of silicious minerals, filling up also the interstices and openings which had formerly contained organic substance. This planet, therefore, must have had a comparatively long period of existence; it must have had an atmosphere and its surface must in whole, or in part, have been covered by water. What the cause has been of its destruction and its utter disintegration we are, certainly, unable to tell; but the meteoric stones which formed part of it have happily crossed the orbit of our planet and thus enabled us to divine its history, at least in part.

In connection with this subject, it may not be amiss to give a short synopsis of the history of our knowledge of organic constituents in meteoric stones.

The first to detect the existence of organic substance in meteorites was the great Woehler. In the meteorite which fell on April 17th, 1857, near Kaba in Hungaria, he found unmistakable traces—while analyzing it—of a combination of Carbon and Hydrogen. Then the fact was remembered that on Oct. 13th, 1835, a fire ball had exploded in the neighborhood of Bokkeveld, Cape Colony, scattering a great number of soft, black stones over the fields, weighing, as far as could be judged, several hundred pounds. These stones emitted a strong ammoniacal smell and were found to be impregnated with water and bitumen. Woehler obtained one of these meteoric stones and found that it contained, besides one and two-thirds per cent of carbon, a quarter of one per cent of organic matter proper.

Referring to this discovery, Friedrich Mohr* wrote, sixteen years ago:

"This is sufficient proof that there was present in this meteorite a carbo-hydrate similar to our ozocerite, idrialite, seberrerite, mineral wax, etc. According to our terrestrial experience we must therefore conclude that on the planet of which they formed part, there must have existed organisms, at least plants, which are the real cause of the many deoxidized combinations which we find in meteorites. The existence of plants would evidently condition the presence of free oxygen, which does not speak against the presence of these products of deoxidation, since the plants themselves require oxygen for completing their cycle, in so far as they are ultimately (by decomposition), re-transformed into carbonic acid, without which condition a long, unbroken chain of vegetable life would be inconceivable. But the water must be liquid in order to act, and this implies that this planet must have had a certain size to enable it to be sufficiently warmed by the sun. The small meteorites, as they come to us, must in spite of their being exposed to the sun's rays, have the temperature of cosmic space, since they are, just as are high mountain peaks, too insignificant to become heated by insolation alone. Only an enlargement of size enables a celestial body to develop heat enough to produce a warm atmosphere. This circumstance supports strongly the view, that meteorites have not been formed independently, but that they have formed part of a larger body, on which processes, similar to those obtained on our planet, have been going on."

This is certainly interesting reading to-day, knowing as we do that the planet in question has also been an abode of animal life.

Other meteorites containing organic substances have been recorded since then. Thus at Orgueil, France, 1864; at Knyahinya, Hungary, June 9, 1866. This phenomenon is the most important since very many of the most convincing specimens, prepared by Dr. Hahn, have been obtained from a stone weighing 27 lbs., which formed part of the 600 lbs. that fell in that particular locality on that day.

The most curious meteoric shower, however, was observed in 1870 in Sweden. Black pieces, consisting almost exclusively of mold, descended on a snow-field, and could thus be easily collected. Mold is always the result of some organic process, and living particles play the efficient part in its production.

Since bacteria are known to be able to withstand a temperature of —100° C, without losing vitality, the Thompson-Richter hypothesis of the propagation of life through the universe in this manner becomes almost a tangible reality. But, we forbear! The perspective opened by Dr. Hahn's discovery is too grand to be discussed in the brief space, allowed this notice. It is only to be regretted that the favored discoverer seems inclined to tamper with his good fortune in so far as he draws conclusions from his newly established facts which few will be willing to admit. He thinks it possible that the formation of living matter may have begun in cosmic space, that cells were developed from Chaos and a certain vegetative process could have gone on in the gaseous and liquid masses supposed to have been the formative matter of our sola-system, etc. Prof. Karsten is even of the opinion that meteorites might form in the upper strata of our atmosphere. As proof he adduces the few recorded showers of polygonal hail-stones and especially the two cases of ice-meteorites. On May 28th, 1802, there fell near Puztemischel, Hungary, a block of ice weighing 1200lbs. and Hayne in his "Tracts historical and statistical on India" reports the fact that near Seringapatam a mass of ice fell from heaven, as large as an elephant, which took, in spite of the tremendous heat, over two days to melt.

* A drawing of this fossil coral is given by DANA in his *Textbook on Geology*, on page 111. (Ed. 1868.)

**Geschichte der Erde*, 1866, p. 500.

If we should be asked our opinion as to what the origin of these ice-meteorites may have been, we should be inclined to answer that they are very probably a small part of the collections of water (oceans?) which, we know, must have existed on the disintegrated planet to which our stone and iron-meteorites once belonged.

The various theories which have been held to explain certain well-known facts about meteoric bodies, notably Schiaparelli's ingenious hypothesis connecting comets with meteorites, the fact that most comets give a spectrum, closely resembling that of carbon, and many others will have to be revised in the light of this discovery, and it may be safely claimed that Dr. Hahn's book will prove to be one of the most important contributions to natural science of the present time.

ASTRONOMY.

Prof. Mark W. Harrington, of Ann Arbor Observatory, announces, in a private letter to the editor, the variability of star D. M. + 0° .2910, the position of which for 1855.0 is

A. R. 12h. 6m. 28.4s. Decl. + 0° 23.5′

It reached its minimum on May 22 or 23, when it was of the magnitude of D. M. + 0° .2914, which is given by Argelander as 8.7. It is now increasing in brightness at the rate of a tenth of a magnitude a day. The star, in the same right ascension and in 15′ south of the variable (D. M. + 0° .2911), is of a fine orange color, and should be put in the list of red stars.

Observers desiring information, charts, or comparison stars, for use in observing the variable, will be cheerfully assisted by Prof. Harrington or the editor.

M. Eugene Block, of the Observatory of Odessa, Russia, has communicated the following observations and elements of Comet (*a*), 1881, Swift:

Odessa M. T.	App. α.	App. δ.
1881 *d. h m. s.*	*h. m. s.*	° ′ ″
May 4 14 50 15	0 15 26.53	+ 33 25 3.7
5 14 28 12	0 19 1.00	+ 32 24 36.7
7 14 36 2	0 26 35.05	+ 30 15 5.9

ELEMENTS.

T = 1881, May 20.8294.

	°	′	″
π =	299	47	53
Ω =	123	59	25
i =	79	33	0

log. q = 9.76570.

The comparison with the middle place gives

Obs. − *c*, $\delta\lambda \cos\beta = -27''$

$\delta\beta = +3''$

Careful search has been made at Boston, at Cambridge by Mr. Wendell, at Clinton, N. Y., by Prof. Peters, and by others, for Barnard's Comet, but without success.

SCIENCE OBSERVER,
Special Circular No. 13.

BOSTON, *June* 2, 1881.

UNDERGROUND WIRES IN PARIS.—The Municipal Council of this city are contemplating adding to their funds by taxing wires placed in the sewers. The proposed tax will be 20fr. per kilometre up to 500, 30fr. from 500 to 1,000, 40fr. from 1,000 to 1,500, and so on, with an increase of 10fr. for each 500 kilometres. *L'Electricité* says that the number of kilometres of wire placed in the sewers being about 7,000, the Compagnie des Téléphones will have to pay something like 59,500fr. It adds that the company make no objection to this tax.

BOOKS RECEIVED.

SECOND REPORT OF THE UNITED STATES ENTOMOLOGICAL COMMISSION, for the years 1878 and 1879, relating to the Rocky Mountain Locust, and the Western Cricket, etc., with illustrations, Washington 1880.

This volume will be read with interest by naturalists, and the facts and statistics relating to the ravages of locusts, and the laws and characteristics governing their migrations are very complete.

The interesting chapter entitled "The Brain of the Locust" opens with these lines. "In order to appreciate the habits, migratory, reproductive, etc., of the locust, and to learn something of its general intelligence as an insect, and as compared with other insects, it is necessary for us to study with a good deal of care the organ of the locust's *mind, i. e.*, its nervous system, comprising its nervous centres and the nerves arising from them. The present chapter will be devoted to a study of the brain."

It may be confidently affirmed that with methods far subtler and reasoning much more profound, than any employed by the author of this chapter, we shall always fail to find in the structure of the nervous system any explanation of the migratory and reproductive or of any other habits *as habits* in any animal. A large wing-ganglion means a flying insect—of course, a large optic ganglion means that vision is a powerful sense in the animal in which it is found; an atropic olfactory bulb, in man the monkeys and seals, means that the sense of smell does not play so important a role in these animals as in the fox, dog, lion, camel and opossum, where the bulb is large. The preponderance of the brachial enlargement of the cord in the mole and bat is related to the preponderance of the anterior extremities over the posterior in these animals, but it no more serves to explain the difference in psychical habits existing between the two, nay it does so to a less degree even than the external structure. There are species of locusts which are not migratory and a study of their brains should be made if Mr. Packard wishes to draw inferences as to habits from the cerebral structure; in other words, if he would trace out the line of demarcation between a "migratory" and a "non-migratory" brain.

We believe that the clause in question has been inserted with the purpose of indicating that there *is* a connection between the chapter it opens and the general purposes of the Report. If so, if it was the writer's object to lead the lay mind to look upon his paper as pointing out methods by which, through a careful pursuit of the logical lines and the ratiocination passing through the cells or nerve-tracts of the locust's nervous system, we should in course of time be enabled to overreach and anticipate him by our superior reasoning power, in a manner comparable to that followed by a detective shadowing a forger, we can only say that it might have been omitted. Science needs no apology and the excellent plates accompanying this part of the Report alone justify the expense incurred by Government in getting them up.

We consider it unfortunate that in a chapter not likely to be perused by the lay reader at all, so much matter of a semi-popular character should have been included. It is the attempt to popularize the distinction between the brain of insects and of vertebrates (p. 224) that has led Mr. Packard to the commission of actual errors. Thus speaking of the nervous system of vertebrates, he says: "The gray matter is situated in the centre and consists largely of nerve or so-called 'ganglion cells,' while the external white matter of the brain or cord is composed of a mass of nerve fibres." This is correct only as applying to the very lowest vertebrates; in man, the mammalia and reptilia, the gray matter is more or less near the surface, in some centers altogether *cortical*, while the white matter is internal. Mr. Packard adds, as another

discrimination: "moreover the entire brain of an insect is white, as are all the ganglia."

On page 226, he says that the outer part of the brain is made up of a "slightly darker, usually pale grayish, white portion"—, where the tissue consists of small ganglion cells; it is naturally . . . . rather darker than in those regions where the tissue consists of the more loosely disposed, large ganglion cells."

So that we have a fundamental contradiction in reference to an alleged fundamental distinction, quite aside from the notorious fact that in the lowest vertebrates the nervous system is as "white" as in insects, and that the convoluted "mushroom" body or "cerebrum" of the ant contains sharply demarcated gray and white substances.

The chapter is accompanied, as stated, by plates of great value, most of these being fac similes of sections prepared by Mr. Norman J. Mason. On the whole, nothing new is added to our knowledge of the adult insectean brain in general, or the locust's in particular, that has not been carefully reported by Floegel, Newton and Michels. But through the great patience and skill of Mr. Mason, Professor Packard has been enabled to study sections from the embryo brain, a subject not yet worked up, owing to the difficulty of preparing the specimens. The most important results obtained is that the nerve-fibres develop from an originally finely granular substance, thus confirming the observations of Schmidt and Hensen for the mammalian embryo.

In view of the loudly trumpeted theory recently revived by Dr. J. J. Mason, after having repeatedly received the *coup de grace* at the hands of Stieda, Meynert and others, that large cells are motor, it is interesting to note that those of the optic ganglion in the locust are among the largest cells in its nervous system. R. C. S.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

To the Editor of "SCIENCE."

Limax maximas L. A specimen of this slug was brought me May 16. It came through a faucet connected with the water works. Being an introduced species and not frequently found, this fact may be of interest.

Polygala pancifolia, wild. Specimens with pure white flowers have been sent from Lunenburg, Mass., two years in succession. J. H. PILLSBURY.

SPRINGFIELD, *May* 27, 1881.

SPECTRUM ANALYSIS.

At a meeting of the Royal Astronomical Society held on the 13th of May, Mr. Norman Lockyer asked permission to offer the following address. He said:

"The chemical constitution of the heavenly bodies is one that demands some attention from astronomers. Twenty years ago the observations of Kirchoff and Stokes enabled us to get some glimpses into the chemical constitution of the sun. Kirchoff's view was that substances with which we are acquainted exist in the atmosphere of the sun, and that their presence was demonstrated by an exact matching both with respect to wave-length and intensity of the lines of certain chemical elements. Before his time Frauenhofer had noted the coincidence of the bright yellow line of sodium with the D line in the solar spectrum, but Kirchoff showed that also in the case of iron, magnesium, cobalt and several other substances there were coincidences between lines, which went to show that what was true with respect to sodium was true with respect to these other bodies. Nine years ago, we had not merely the opportunity of comparing these bright lines in the spectrum of the sun's atmosphere, as revealed to Frauenhofer, but we had the opportunity of studying the spectra obtained from very small portions of the sun's atmosphere, in regions where we should expect an exceedingly high temperature—namely, in the regions of spots and in the regions of prominences. When we began to examine these spectra, we found that the lines were thickened, and the question appeared much less clear than it did before. Of 460 iron lines recorded by Kirchoff, only three were observed in the prominences, and these were not the lines that were seen thickened in spots; so that a great many fresh questions were raised, and the idea of the decomposition of the iron by the high temperature was forced upon us. I wish to bring before you to night the results of some purely astronomical inquiries, lately undertaken by the Solar Physics Committee with respect to the behavior of the lines in the spectra of spots and prominences. We had before us the admirable work undertaken by Prof. Young in 1872, on the spectra of the prominences; but his observations only lasted for a month, and we felt that we wanted more facts, so what we have been doing at Kensington during the last two and a half years, has been to obtain and tabulate the spectra of a hundred sunspots, and these we have compared with the Italian observations of prominence lines. It was impossible to note and map down the behavior of all the lines in the spot spectra. The Committee, therefore, attempted something which was more modest, and contented themselves with observing twelve lines in the most easily visible part of the spectrum, between F and D (pinned to the blackboard was a diagram with the spectra observed placed one beneath the other, at the top were the iron lines of the Frauenhofer spectrum stated by Angstrom to be coincident with the bright lines of iron). The first point which strikes one on examining this diagram is the enormous number of iron lines, both in the solar spectrum and in the iron spectrum, as mapped by Angstrom, who used an electric arc of thirty or more Bunsen cells. They remind one of a great piano, only a few notes of which are played over and over again in the spot spectra, but always producing a different tune. If you examine the lines individually, you will find that every line has been seen with every other line. One is struck by the marvellous individuality, so to speak, of each. The lines do not go in battalions, or companies, or corporal's files, but in single units. The great importance of obtaining these observations is not so much for the observations themselves, as for the comparison they enable us to make with the observations of the lines in prominences, because the prominences are hotter than the spots. The spots are caused by down-currents where the solar atmosphere is brought down from cooler regions. They are opposed to prominences, which are ejections of heated matter from the interior of the sun. Here (pointing to the diagram) we have arranged the observations of prominences by Tacchini since 1872. What is the result? First of all, you will note a very great simplification; the brightest part of the sun has given the fewest lines. Next, there is not a single line common to the two series. In passing from the iron lines in the spots to the iron lines in the flames we pass from one spectrum to another, and the two spectra are as distinct from one another as the spectrum of magnesium is distinct from the spectrum of chlorine, or any other substance you please. These phenomena are the last we should expect. We can understand that a difference in the quantity of iron vapor present, might make a certain difference in the spectrum; but we are driven to something quite independent of any change corresponding to quantity. We see that as the temperature is increased the simplicity of the spectrum is increased; just as a chemist finds with regard to the substances which he has under his control, the function of temperature is to simplify. Why, then, if this is the result of working with increased temperature here, should not the simplification be due to the breaking

up of the iron into simpler constituents? Mr. Lockyer went on to state that the probability that the elements are so broken up by the intense heat of the lower regions of the solar atmosphere is increased by finding that many of the lines seen in the lower regions are common to more than one element. He did not believe that the bright lines seen at the beginning and end of totality which are frequently spoken of as belonging to the reversing layer correspond to the dark lines of the Frauenhofer spectrum. In witnessing another total eclipse he should concentrate his attention on two of the basic iron lines, and note their behavior at the instant of totality.

Mr. Ranyard said: It is some years since we have seen Mr. Lockyer at a meeting of the Society. I am glad to see him here again, not only for the sake of the very eloquent lecture which he has given us, but also because of the influence which a Society like this is likely to have on those who read papers before it. It gives an opportunity of criticising theories and of asking questions, which is no doubt beneficial to the person who brings the theories forward. Mr. Lockyer has referred to a theory, which he has very widely discussed, with regard to the non-elementary nature of the elements, and the evidence to be derived from solar observations, I understood him to say that he would expect a greater heat to give us a less complex spectrum.

Mr. Lockyer: I never said anything of the kind.

Mr. Ranyard; I was about to say that the reverse appears to be the case. I hope that Mr. Lockyer will afterwards take the opportunity of explaining what he means. The spectrum of the photosphere is very complicated as compared with the spectrum of sunspots and prominences. If any fact needs dwelling upon with respect to the sun, it is the number of lines which cannot be matched with terrestrial elements, and the complication of the spectrum increases as you proceed downwards to the sun's limb; that is, as you proceed from cooler to warmer regions. In the region of the Corona, very few lines have been observed; that may be, it is true, because of their faintness; but with the exception of the hydrogen lines, the lines seen in the spectrum of the Corona, which, of course, is much cooler than the region of the chromosphere, do not correspond to known lines of any terrestrial element. There is, of course, an enormous field for study here; but the fact which I want to point out, is that you do not get a simplified spectrum in the sun with greater heat, and if the facts which Mr. Lockyer has referred to with regard to the common lines in the spectra of different elements are to be relied upon, it will not follow that the common lines correspond to the similar parts of the two elements, and that the other lines correspond to mere overtones, given out with greater heat. But I should like to ask Mr. Lockyer whether he has taken note of the observations of Professor Young, who has examined these lines common to two or more elements in the solar spectrum with great dispersion, and has found that they nearly all break up into double lines or groups of lines. I think out of fifty-seven lines all but four were shown to be thus broken up, and there was some doubt about these four.

Mr. Christie said: Similar observations to those which Mr. Lockyer has described with regard to the spectra of Sunspots have been made at Greenwich, and without adopting his theory, I may say that our observations agree with those which have been made by Mr. Lockyer. We have not confined our attention merely to the iron-lines which are thickened in the spot spectrum. But we perfectly confirm what Mr. Lockyer says, namely that in the spectrum of one spot there is one group of iron-lines thickened, while in the spectrum of another spot, there will be an altogether different group affected.

TERRESTRIAL MAGNETISM.—The French Government are about to establish an observatory for terrestrial magnetism at Cape Horn.

A NEW DISCOVERY IN PHOTOGRAPHY.

At the last meeting of the Photographic Society of Great Britain, Mr. L. Warnerke described the discovery he has recently patented. The discovery he said consisted in the fact that a gelatine plate submitted to pyrogallic acid became insoluble in those parts acted upon by light, exactly in the same way as gelatine was acted upon by chromic salts, the insolubility being in proportion to the amount of light and the thickness of the gelatine. This property he proposed to utilize in various ways. The drawback in the ordinary gelatine process was that unless the exposure were very accurately timed there was considerable danger of over-exposure, and, as intensification was very difficult, pictures by the gelatine process were often inferior to those by collodion. By the new process he was, however, able not only to intensify, but also to overcome the drawbacks arising from over-exposure. The latter he effected by using the emulsion on paper. He had found that no matter how much the paper was over-exposed the picture—provided the developer was restrained sufficiently—was not injured, while in the case of the emulsion on glass there was not only halation of the image, but a reversal also. The transfer of the image from paper on to the glass was a very easy matter. The paper was immersed in water and placed in contact with a glass plate. The superfluous moisture was removed by a squeegee, and the paper could then be stripped off, leaving the tissue on the glass. Hot water was then applied, which dissolved all the gelatine not acted on by light, together with the free bromide or soluble salts, and the image was left upon the glass in relief. Intensification he effected by mixing with the emulsion a coloring non-actinic matter, which was not affected by silver. Aniline colors he had found answered the purpose, and in that way special emulsion for special purposes could be prepared. That method of preparation he thought would be especially suitable for magic-lantern slides. He claimed for his discovery that by it relief could be obtained far more easily than by the ordinary bichromatised gelatine, and therefore it was especially suitable for the Woodburytype process. By mixing emery-powder with the emulsion it was rendered fit for engraving purposes, and by a combination with vitrified colors the image could be burnt in and so was adapted for enamels. In the ordinary methods of producing enamels from carbonised gelatine the latter, from the difficulty of burning it without the formation of bubbles, was a great source of trouble. By using a suitable emulsion, however, so little gelatine might be employed that this drawback was overcome. The process could also be adapted for collotype printing. In the course of his remarks, Mr. Warnerke demonstrated the removal of a gelatine picture produced by his method from paper on to glass, and showed that the mere immersion and washing in hot water fixed the picture by the dissolving of the gelatine unacted upon by light, which thus carried away the free bromide of silver. In conclusion, he stated that the sensitive paper could be used in the camera in lengths wound on rollers, and exhibited a camera which he had made for the purpose.

Captain Abney, after some remarks in reference to halation and reversal of the image, remarked that in the production of enamels by Mr. Warnerke's process there was some danger of the silver producing the well-known yellow colour which spoilt so many vitrified photographs. The discovery made by Mr. Warnerke was a most important one, and in regard to Woodburytype, really opened up quite a new era. Mr. W. S. Bird endorsed Captain Abney's remarks as to the value of the process. To be able to produce gelatine negatives without the fear of the yellow stain was a great boon, and the only point was whether photographers would take the trouble and risk in the necessary transfers. As to its adaptability to Woodburytype, there could not be the slightest doubt. The great difficulty was to obtain the necessary relief, and he knew of a company which had recently gone to a great expense to fit up the necessary machinery, when Mr. Warnerke was able to give them what they wanted at a merely nominal cost.

Mr. T. Sebastion Davis also referred to the importance of the discovery, and suggested that by the use of the emulsion on paper a landscape might be photographed in which the clouds and the foreground might be rendered with equal truth, instead, as was too often the case, of the sky

being over-exposed. Mr. T. Bolas inquired whether Mr. Warnerke had tried adding bichromate of potash to his emulsion. The addition of bromide of silver in the case of a carbon print was supposed to increase its sensitiveness, but whether it did so he could not say. Mr. Warnerke in the course of his reply, said he had not found the yellow colour spoken of by Captain Abney, in the enamels which he had made. It was possible to eliminate all the silver by the use of ferric salts. With regard to Mr. Davis's suggestion, he was afraid he must throw cold water upon it, for he did not think it could be realized unless he used a developer for the clouds different from that used for the foreground. He had not tried bichromate of potash as mentioned by Mr. Bolas.

ESTIMATION OF FAT IN MILK.

The plan I adopt is as follows :—10 grms. of milk are evaporated in a platinum boat (of suitable construction), to near dryness (to complete dryness if you wish to determine the total solids) in the water-bath ; the boat is now inserted into the extraction tube (which is plugged with a little cotton-wool and contains a stopper in the narrow part of the tube), and then connected to an upright Liebig's condenser. A small tarred flask is now fixed on to the end of the extraction tube (50 to 100 c. c. capacity) containing ether. The ether is evaporated by means of hot water, and when sufficiently condensed in the tube above, so as to completely cover the platinum boat, the stopper of the extraction tube is turned and the ether allowed to remain for about six hours or all night if convenient. All that now remains to be done is to cautiously open the stopper and allow the ether and oil to flow into the tarred flask ; boil the ether repeatedly until extraction is complete. Disconnect the flask, evaporate the ether dry, and weigh the oil. The platinum boat may also be taken from the extraction tube, dried in water-bath, and weighed, which will give the solids not fat, then ignited and weighed, and we have the ash. If there is any doubt in the mind of the operator that the ether has not been able to penetrate the residue, after there have been several extractions made, the boat may be withdrawn from the extraction tube, the residue detached from its sides by means of a small platinum spatula, and the whole again returned to the extraction tube, and the operation of extraction repeated. When the extraction has been conducted as described, there is no fear of any fat being left undissolved in the residue. The following duplicate analyses are the results I have just obtained from a sample of milk I have reason to believe is genuine or unadulterated. The amount of milk operated upon was 10 grms. Specific gravity, 1027·3.

Total solids.....	10.2440	10.2448
Fat.....	1.9940	2.0001
Solids not fat.....	8.2500	8.2447
Ash.....	0.6940	0.6960

WILLIAM JOHNSON, F.I.C., F.C.S., &c.

THE ELECTRIC RAILWAY.

One of the novelties at the Crystal Palace, London, on Easter Monday, was the opening of an electrical railway, constructed by the Société Anonyme d'Electricité of Brussels, on the Siemens system. On the upper terrace of the Palace grounds, overlooking the charming scenery of Sydenham, a miniature circular line of railway, consisting of three lines of metals, has been laid down, surrounding one of the ornamental ponds, and a small wooden hut erected beside it as a passenger station. On this railway, which is about 300 metres in length, and has a gauge of about 50 centimetres, or 19 inches, between the outer rails, stands the electrical locomotive. Its length is about four feet ; its breadth about a metre ; its height about as much, and its weight some three-quarters of a ton. It is, in fact, a Siemens dynamo-electric machine, neatly boxed in, and mounted on a truck with four metal wheels, and provided with a break and alarm bell for its control by the man in charge. A stationary engine of about eight horse-power nominal, in a shed about thirty yards from the railway line, drives a stationary dynamo-electric machine, from which the electro-motive current is primarily obtained. Two wires are connected with this fixed dynamo-machine. By one of them the current flowing out is conveyed to the mid-rail of the railway, to which it is attached by an iron plate bolted on. The second or return wire is attached to the exterior rail of the railway. The mid-rail is supported upon wood blocks, and is thus in a certain degree insulated. Beneath the electrical locomotive a brush of iron wires sweeps the mid-rail, and the electrical current is thus taken up into the locomotive, where it passes through the mounted Siemens machine within it, the large bobbin of which is thereby caused to revolve, and the current passing away by the wheels of the truck to the exterior rails of the road, is conveyed back to the stationary dynamo-machine. As the current thus circulates, and the bobbin of the mounted machine revolves, it drives the four wheels of the truck as the locomotive moves on, hauling after it a load of nearly three tons with ease at the speed we have named.

NOTES.

INTERNAL DISCHARGES OF ELECTRIC CONDENSERS.—B. Villari.—The author's conclusions are that the heat evolved by the internal discharge may be neglected in case of feeble discharges; beyond certain limits it manifests itself and increases very rapidly with the discharges themselves ; thus the first means to augment this internal heat is to make use of jars charged to a very high potential. The internal discharge is sensibly augmented if the exterior spark is produced between two small balls of 20 to 30 mm. in diameter ; it decreases, on the contrary, by almost one-half if the spark is taken from a point and one of the balls. The inverse is the case for the heat produced by the external exciting spark. For a given charge the internal discharge increases if the inner coating of the jar is diminished.

RESEARCHES ON THE CHANGE OF STATE IN THE NEIGHBORHOOD OF THE CRITICAL POINT OF TEMPERATURE.—L. Cailletet and P. Hautefeuille—The authors remark that near the critical point there are witnessed for very slight variations of temperature, phenomena which have led Andrews to regard the gaseous and the liquid states as distant terms of one and the same state of matter, which may pass from one to the other by a continuous series of changes. It is impossible to know what is the state of the matter which gives rise to the moving and wavey striæ which displace each other above the mercury on operating in the vicinity of the critical point. A slow decrease of pressure often shows if a tube is filled with a liquid or a gas, for in the latter case the release gives rise to a general mist and to liquid drops ; but this procedure furnishes no clue to the nature of these striæ. The authors have overcome this difficulty by coloring carbonic acid with the blue oil of galbanum. They have found that these undulating striæ dissolve the oil, and are consequently produced by liquefied carbonic acid. They conclude that matter does not pass by insensible degrees from the liquid to the gaseous state.

ON THE ACTION OF THE SELENIUM RADIOPHONE.—M. E. Mercadier observes that the sounds produced in the selenium receivers which he has studied result chiefly from the luminous radiations. The rays of the spectrum act from the limit of the blue, on the indigo side, as far as the extreme red, and even a little beyond the red. The indigo, violet, and ultra-violet rays are without perceptible action in the conditions under which he has experimented. The maximum effect is always produced in the yellow portion of the spectrum. Radiophones with glass tube-receivers containing air, in contact with a smoked surface, give a different result, the action being principally thermic.—*Comptes Rendus.*

LAW RELATING TO CABLES.—*L'Electricité* says that there is some idea of appointing a commission to inquire into the state of international law relating to submarine cables. The Minister for Foreign affairs in France, M. St. Hilaire, has stated that, in case the forthcoming Congress of Electricians should arrive at any decision on the subject, he will send a circular to the various Governments suggesting the holding of an international conference.